09/762607

JC05 Rec'd PCT/PTO 0 8 FEB 2001

Description

Telecommunications installation

The present invention relates to a telecommunications installation according to the preamble of claim 1.

Telecommunications installations of this type, for example those used as node points in ATM communications networks, are program-controlled, i.e. they comprise one or more control computers to control the functions of the telecommunications installation. Control software in the form of an application program system (APS) is implemented on the control computer. Furthermore, the control computer has a database system to store work data which is used together with the application program system to control the telecommunications installation. Along with a control computer of this type for administrative control of the telecommunications installation, an additional control computer is normally provided to control the actual hardware of the telecommunications installation, i.e. to control the switching system. For reasons of security, the control computers described above are preferably provided in duplicate, in order to avoid total failure of the telecommunications installation, in the event of failure of one control computer, by means of the redundancy thus created.

During the operation of an application program system, destruction of the system software, i.e. the APS file system, or inconsistencies in the databases implemented on the control computers may arise, for example due to hardware or software faults or as a result of voltage failure or incorrect operation, which cannot be cleared even by means of the aforementioned redundancy resulting from the duplication of the control computers. Faults may also occur when an

application program system is changed due to incorrect operation or hardware/software problems, which could result in database corruption.

In the event of faults of this type, the application program system, for example backed up on a magnetic tape, hitherto had to be loaded into the telecommunications installation again and therefore restored. In the event of database destruction, the database had to be reinitialized and the previously existing connections running via the corresponding telecommunications installation had to be reloaded, for example, with the aid of a batch file. An at least temporary failure of the connections was then inevitable.

In addition to the aforementioned problems in the event of faults in the APS file system or database of a control computer, known telecommunications installations were also disadvantageous in that, during a test system operation of the relevant telecommunications installation in the event of a test level changeover, a major database modification was often required, which could be relatively time-consuming.

The present invention is therefore based on the object of producing a telecommunications installation which enables simpler and, in particular, faster changeover of the software of one application program system to the software of another application program system, which is required, for example, if faults occur in the file system of the active application program system. In addition, the present invention is preferably intended to enable simpler test system operation of the telecommunications installation and simpler clearance of faults in the active database of the control computer of the telecommunications installation.

The aforementioned object is achieved according to the present invention by a telecommunications installation with the features of claim 1. The subclaims describe advantageous and preferred

embodiments of the present invention, which in turn contribute to the simplest and

fastest possible changeover of the application program system or corresponding control software.

According to the present invention, the control computer comprises a plurality of application program systems (hereinafter referred to as APS file systems for the sake of simplicity), which, for example, are set up in different memory areas of the hard disk of the control computer of the telecommunications installation. Only one of these APS file systems is set to be active during a re-installation or changeover of the application program system, while the other APS file systems are declared to be passive. The telecommunications installation is then controlled according to the APS file system which is declared to be active. The switchover from one APS file system to another is simply performed in that the currently active APS file system becomes passive and one of the currently passive APS file systems becomes active.

A corresponding database for work data is advantageously connected to each APS file system. According to the preferred exemplary embodiment, in particular two pairs of APS file systems/databases are set up on the control computer. The active APS file system and the active database are set up via a special mechanism to start up the telecommunications installation, while the other APS file system and the other database are declared to be passive. The telecommunications installation is then controlled by the control computer on the basis of the active APS file system or corresponding APS software and the work data of the active database. In this way, the disk memory capacity of the control computer is effectively used through declaration of an active and a passive half in order to enable faster changeover between the installed APS file systems or corresponding databases, whereby in particular a fallback position can be created for possible emergencies by transferring a copy of the active APS file system and the active database

to the initially passive memory area of the control computer in such a way that, even if the redundant control computer is unavailable in the event of a fault, operation of the telecommunications installation can be maintained.

The invention is explained in detail below by means of a preferred exemplary embodiment, with reference to the attached drawing.

Figure 1 shows a simplified block diagram of a telecommunications installation according to the present invention, and

Figure 2 shows a detailed block diagram of the components illustrated in figure 1, which serve to control the telecommunications installation.

The telecommunications installation 1 shown in figure 1 serves to switch voice, image, text and data connections between the subscribers of a telecommunications network, in particular an ATM telecommunications network, allocated to the telecommunications installation 1. The telecommunications installation 1 preferably operates digitally, i.e. digital information transmission takes place within the telecommunications installation 1. The telecommunications installation 1 comprises, as central components, a digital switching network 4, which represents the actual switching equipment of the telecommunications installation 1. The switching network 4 enables "physical translocation" from one transmission line connected to the telecommunications installation 1 to another transmission line, and "temporal translocation" from one transmission channel to another transmission channel. The digital switching network 4 is normally divided up into individual switching network modules or switching stages.

Different subscribers and transmission lines, which are fed via line adapters 2a-2c to the digital switching network, are allocated to the telecommunications installation 1. If required, analog/digital conversion is carried out in the incoming direction and digital/analog conversion is carried out in the outgoing direction in the line adapters 2a-2c. The line adapters 2a-2c may be connected, e.g. via PCM transmission lines having in particular 64 channels, to the digital switching network 4. For the sake of simplicity, a plurality of subscriber lines 3 are shown in Figure 1 for the line adapter 2a only, wherein these subscriber lines may be allocated to both analog and digital subscriber terminal devices or further network nodes. The line adapters 2b and 2c are of course also connected in each case to a multiplicity of subscriber lines 3.

The telecommunications installation 1 is program-controlled. This is done with the aid of a controller 5, which receives the connection requests of the subscribers of the telecommunications installation 1, carries out the routing and controls the entire telecommunications installation 1, in particular the hardware of the telecommunications installation. As explained in more detail below, the telecommunications installation 1 is controlled in particular according to the application program system (APS), which is implemented on the telecommunications installation 1.

In the example shown in Figure 1, the function of the controller 5 is divided up into two halves, which run on two separate computer systems. One computer system, referred to as PCE, is used for administrative control of the telecommunications installation 1, in such a way that the application program system (APS) essentially runs on this computer system. The second computer system, referred to as GPE, is used primarily to control the actual switching

system, i.e. in particular the digital switching network 4, of the telecommunications installation

1. In contrast to the computer system PCE, the computer system GPE is therefore more hardware-oriented and supports the switching system processes. Both computer systems PCE and GPE are provided in duplicate for security, in order to prevent the entire telecommunications installation 1 from crashing if one computer of the relevant computer system fails. According to the embodiment shown in Figure 1, the computer system PCE therefore comprises two control units PCEU0 and PCEU1, which are formed by the control computers 6a and 6b shown in Figure 1. The computer system GPE analogously comprises two control units GPEU0 and GPEU1, which are formed by the control computers 6c and 6d shown in Figure 1. Within the individual computer systems PCE and GPE, one control computer can therefore in each case perform the function of the other control computer if the latter fails, in which case one control computer is operated in an active mode and the other control computer is operated in a standby mode. As explained in more detail below, the computer system PCE provides not only operating functions but also nonvolatile memory media of the telecommunications installation 1 and performs central control functions. The computer system GPE on the other hand has no secondary memories and performs the real-time control functions for the peripherals and for the switching network 4 of the telecommunications installation 1.

Figure 2 shows details of the configuration of the controller 5 shown in Figure 1.

The control units PCEU0 and PCEU1 can be implemented by means of normal personal computers 6a and 6b. A mouse 10a and 10b and/or a keyboard 11a and 11b are available as input media. Hard disks 7a and 7b, disk drives 13a and 13b and/or streamer drives 9a and 9b can be provided in each case as secondary memories. Furthermore, a CD-ROM drive 8a and 8b is in each case provided to enter, i.e. load, software. A monitor 12a

and 12b

is connected to each control computer 6a, 6b, and a printer 14a and 14b, respectively, is additionally allocated to each control computer.

The two partner control computers 6a, 6b are, for example, interconnected via an Ethernet connection 17. The two control computers 6a and 6b can furthermore be connected via the Ethernet connection 17 to a service multiplexer, via which, for example, lines can be connected according to the E1 transmission standard of the relevant telecommunications installation 1. In the embodiment shown in Figure 2, a V.24 connection 16, which serves to locate faults in the event of possible failure of the Ethernet line 17, is routed in parallel with the Ethernet connection line 17.

In order to be able to communicate, inter alia, with remote workstations, each control computer 6a, 6b has connections 18a and 18b, which are designed in particular in the form of an X.25 connection and are implemented with the aid of a dedicated plug-in card. In addition, interface cards 21a, 21b are provided, via which the control units PCEU0 and PCEU1 can be connected with the aid of corresponding connections 22a and 22b to the control units GPEU0 and GPEU1, which are implemented by the aforementioned control computers 6c and 6d.

Finally, for synchronization, a remotely controlled clock 15 is also provided, which is preferably connected via V.24 interfaces to the two control computers 6a, 6b. However, a radio clock 15 of this type is provided only in telecommunications installations which are designed as central units.
Finally, the control units GPEU0 and GPEU1 implemented by means of the control computers 6c, 6d are connected to the switching network 4 shown in Figure 1 and the peripherals of the telecommunications installation 1, and furthermore have

connections to output fault messages. Furthermore, these two control computers 6c and 6d are interconnected via a link-channel 23 to exchange hardware status messages with one another.

UNIX can be used as the operating system on the control units PCEU0 and PCEU1, and also a user interface based on X-Windows and the OSF-Motif. The ORACLE relational database management system is preferably used for data organization.

As already mentioned, with the redundancy implemented by means of the control computers 6a and 6b, and 6c and 6d, only one of the control computers 6a and 6b, and 6c and 6d, is active, while the other of the relevant control systems PCE and GPE is in standby mode. Only a restricted, rather than the complete, command scope, for example configuration commands, is offered on the relevant standby control computer, in order to turn the standby computer into the active control unit.

When activated, the two control computers 6a and 6b of the computer system PCE control the telecommunications installation 1 in each case depending on the software of an activated application program system (APS) and the work data of an activated database. This will be explained in detail below with reference to the control computer 6a serving as the control unit PCEU0.

As shown in Figure 2, the control computer 6a accesses a specific data stock 24 which comprises the software for the application program system and the database. This data stock 24 is located in particular on the hard disk 7a of the control computer 6a. According to the present invention, the data stock 24 comprises a plurality of APS file systems and preferably also databases, in each case only one pair of APS file systems/databases being activated and the other pairs

being deactivated. According to the preferred exemplary embodiment shown in Figure 2, in particular two pairs of APS file systems/databases are set up, wherein one memory area 19 has the software for one APS file system APS1 and the work data for a database DB1, while another memory area 20 comprises the software for a further APS file system APS2 and the memory area for a further database DB2. The APS file system APS1, along with the database DB1, forms an associated pair, whereas the APS file system APS2, along with the database DB2, likewise forms a corresponding pair. Alternatively, situations are also possible in which the two APS file systems APS1 and APS2 interwork with the same database DB1 or DB2. This may arise in particular following an APS changeover without modifying the database functionality on economic and time-saving grounds.

The relevant active APS file system and the active database are set in each case in the control computer 6a by means of corresponding control information via a special mechanism in the event of a re-installation or changeover of the application program system or a changeover between different application program systems. It is then assumed that, in the exemplary embodiment shown in Figure 2, the APS file system APS1 is initially set as the active APS file system and the database DB1 is set as the active database.

With the aid of the configuration shown in Figure 2, a simple APS changeover can be carried out accordingly by deactivating the APS file system APS1 and by activating the other APS file system APS2. A simple database changeover can be correspondingly implemented by deactivating the database DB1 and by activating the database DB2. An APS changeover of this type is appropriate particularly in the event of operational disruption, if no correct control of the telecommunications installation 1 can be implemented

with the aid of the initially active APS file system APS1.

However, in the case of an APS changeover of this type, the computer 6a must temporarily assume an undo or pause setting in order to avoid an overlap of the active and passive positions of the individual APS file systems or databases.

During periods of little or no operation, a fallback position can be very simply created for the control computer 6a by copying the contents of the initially active memory area 19 into the passive memory area 20 in such a way that the passive APS file system APS2 corresponds to the active APS file system APS1 and the passive database DB2 corresponds to the active database DB1, in order to guarantee reliable control of the telecommunications installation in a possible emergency, even if the redundant PCE control computer 6b is unavailable, by changing over to the memory area 20 with the APS file system APS2 and the database DB2.

During the installation of an application program system, the application program system which is still active remains active. Only if a database changeover is required during installation is there a need for a temporary changeover to the passive database, in the example shown in Figure 2 to the database DB2, in order to initialize a new database there and start the data transfer.

In terms of an APS changeover, a distinction is made between different types of a changeover of this type. Thus, for example, only the APS file system may be affected by a changeover of the application program system, so that, in this case, only the currently active APS file system is shut down and the new APS file system needs to be started up. If, on the other hand, the database memory area is also affected, the old database must also be shut down and the new database started up. In addition, the entire control computer is fully rebooted. The GPE control computer may equally be affected by an APS changeover, so

that, in this case, the GPE control units GPEU0 and GPEU1 must also be re-initialized if required. In order to control these different cases of APS changeovers, a specific restore or recovery stage must be allocated to each APS changeover, and is stored in the control computer 6a in the form of corresponding control information. With the occurrence of an APS changeover, the control computer 6a can determine and apply the relevant recovery stage with the aid of this control information, in order to carry out the controller restoration as effectively as possible in this way. The redundancy requirements must essentially be observed here, i.e. the relevant APS file system/database pairing must match, the active control computer remains active and the control computer in standby mode must be shut down to prevent interference with the controller.

It is evident from the above description that, according to the present invention, only one APS file system/database pair is active. The other, initially passive, pair can be accessed, for example, via a fallback mechanism in the event of an emergency via the active application program system or, for example, in test system operation in the event of a test level changeover, via the application program system of the preceding test layer, in order to activate this APS file system/database pair.

In the exemplary embodiment shown in Figure 2, only two pairs of APS file systems/databases are set up. However, the present invention can of course be applied to more than two such pairs, in which case it must be guaranteed that only one of these pairs is activated and the other pairs are deactivated. Furthermore, the controller has been explained with reference to Figure 2 purely in terms of the control computer 6a, i.e. in terms of the PCEU0 control unit. However, the above description applies analogously to the redundant

control computer 6b also, i.e. the PCEU1 control unit, in which case a plurality of pairs of APS file systems/databases are likewise advantageously set up and only one of these pairs is activated.

With the aid of the present invention, the capacity of the hard disk of a control computer 6a, 6b can be effectively used in order to quickly carry out an APS changeover and switch over to a new APS. This is particularly advantageous in the event of a test level changeover in test system operation of the telecommunications installation 1. Furthermore, this is advantageous in the event of an emergency, in order to guarantee reliable control of the telecommunications installation by means of an APS changeover even if the redundant control computer is unavailable.